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Measurement of the Human Factor in Industry

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No definite and permanent advance is made in any kind of work, whether with materials or men, until use is made of *measurement.* This is especially true of advancement of the human factor in industry, which varies so much that unless we use measurement and abide by the results, there is no possibility of repeating the process accurately and efficiently at will, or of predicting and controlling the future conditions that assure that advancement.

The first step in any great movement is to do exactly what this Society is doing at this Conference—to arouse interest in the subject, to discuss the great problems involved, to outline the possible solutions, and to assign the various problems to those best fitted to undertake and handle them.

The next step is to realize that all this discussion, valuable as it is, can grow into such action as it deserves, only if measurement is insisted upon from the very beginning of making the investigations outlined, if the records of measurement are in such form that they can be used by those who did not make them, that skill and experience may thus be transferred, and if the results of the measurements are incorporated into actual and universal practice as soon as they are properly synthesized into practical methods of least waste.

The world has come to realize the truth of this as applied to material things. The day of standardization of materials and of machines is far advanced, and is daily progressing; but such has been rarely the case with measurement as applied to the human element.

The design of machines is constantly changing; the human being is constant. Measurement on machines that are obsolete is of little value. Measurement of human beings is valuable forever. Such old saws as "Genius must be unconfined and uncriticised," "Skill is not a matter of measurement or of teaching, but of natural aptitude alone," "Expertness is the same as efficiency and the expert often develops as a lone worker and with no thanks to

measurement," have stood in the way of measurement. So have such ideas as that measurement of the human factor, and the supplying of work that this measurement shows to be the most appropriate, lead to monotony.

Now it is a matter of no difficulty to state the facts in their proper terms to an unprejudiced and open mind. Measured investigations prove that genius develops best and fastest when provided with such opportunities as measurement of the genius show as necessary, and when relieved of all restrictive occupation and distraction. They also show that skill *is* largely a matter of training, and that greatest skill can be acquired in the shortest amount of time when right habits are acquired as a direct result of right methods having been taught from the start, and the human factor in the learner and the teacher having been carefully measured.

Most interesting of all, perhaps, is that recent investigations prove absolutely that while expertness and efficiency may be possessed by the same individual, often the expert is not an efficient worker. One of the most expert and most successful orthodontists in the country was proved by motion study measurement to be most wasteful of her motions and of her strength. Many an expert worker in the industries, in the professions and in the sports shows every evidence of working with speed and with a resulting output high in quality and quantity, but with a resultant fatigue entirely incommensurate with real efficiency. This is no mere theory of ours, not something that we merely base on "what might be" or "what could be," or "what we believe is." It is the actual condition of affairs, as we can prove by records made on recognized experts and champions in numerous lines of activity.

As for the idea that measurement leads, directly or indirectly, to monotony—it has been the direct results of measurement that have proved to be the great factors in eliminating monotony, and in injecting interest into all kinds of work.

Monotony is the result not of measuring the activity, or the human factor in the activity, but of wrong assignment and placement to work, or of such repetition of work that the mind is forced to follow a cycle of activity again and again, with nothing to stimulate during the process. It is the measurement that has resulted in better placement, and in assigning each individual to that type of work for which he will become best fitted and that he finds interesting. It is the measurement, and the theory and practice of measurement that is taught the individual at the work, that makes him interested in the work itself, in his motions in

performing it, and in the rest intervals that enable him to perform the most output with the least fatigue.

How are these measurements made? Through advances in laboratory psychology, through educational psychology and through advances in laboratory practice in the industries, it is now possible to record, accurately and in great detail, not only what the activity is, its elementary and over all times, and the paths through which it moves, but also the results. Progress might be greatly accelerated by closer cooperation between workers in various lines all interested in the same problems, though often they fail to realize this fact. Physiologists, psychologists, industrial engineers, managers, and other experts are all interested in so many of the same problems as to astound anyone who understands the various problems, and can compare the investigations in comparative activity now being made. Yet many of the most prominent workers in all these lines, not to speak of the world at large, fail absolutely to realize that the problems being considered *are* common to all and that the results could be of use to the world very much quicker if there was more close cooperation during the period of investigation. Methods and devices could easily be transferred from one type of laboratory to another, findings could be correlated and results classified and utilized to an extent scarcely dreamed of today.

As for the methods and devices in use in industrial investigations in particular, we have already presented to you on previous occasions data concerning some of those that we use and have found most helpful. It remains but to say here that these are at the disposal of the nation in this emergency, and have been placed by us already at the national service.

In order to illustrate and to make more concrete the need of measurement in considering the human factor, we bring to you today especially and as one typical example of the whole the problem of the cripple—the war cripple and the industrial cripple —both of whom constitute elements seriously to be considered in the great problem of preparedness.

Ever since various visits to the warring countries, particularly after the war, and an intensive consideration and study of the problem of the crippled soldier, we have put all possible time, with no remuneration, to the consideration of the problem of re-educating and utilizing the crippled soldier and the crippled
r of the industries.
realize fully that this is not the time to bring the problem
war cripples before the youth of the nation in such har-

rowing form as to prevent enlisting, or in anywise diminish the militant spirit that must exist if our national plans are to be successfully carried through. We realize also, however, that if this country is to succeed better than did the countries abroad in handling this problem, it must be seriously considered *immediately* by such bodies of mature men as this Society. No one realizes more strongly than do the workers in the reeducation of the cripples abroad, the need of our nation preparing a Bureau or Department along this line. We had, only a few days ago, a letter from Professor Jules Amar, the great French scientist, who is devoting his time and resources to this work, who has government backing and the most marvelous equipment, and with whom we have been cooperating in crippled soldier work for some time. In this letter Professor Amar urges that this country prepare itself not only along military lines, but along all other lines, for the proper handling of its soldiers. And the French have succeeded in this line with their remarkable ingenuity far beyond any other nation.

We have a well defined purpose in bringing this subject to the attention of this meeting, which will be brought out plainly at the conclusion of my paper. Let us here outline the things that have happened abroad and in Canada because there has not been sufficient attention paid to measurement of the human factor, and sufficient preparedness to handle the problems that have arisen.

In the first place, there was a universal lack of realization of the great difference existing among the cripples, and of the need of placing each man in that work not only that he was best fitted to do, but that he would most enjoy doing, and that would arouse and hold his interest most successfully and permanently. In the second place, there was a lack of realization of the many more opportunities available for cripples than had been realized. In the third place, there was a lack of realization of the necessity of supplying the proper and fitting reeducation for the productive output at the earliest possible moment, in order to bridge over the period of discouragement and despondency, and to help the cripple to fit back into the economic world and its work.

In the fourth place, there was a failure to impress upon the cripple, from the earliest possible moment his *likeness* to other people and to other workers, rather than his *differences*, and, therefore, as a result, a failure to provide for that *social* element in the work that is necessary, if his permanent happiness is to result. In the fifth place, there was a failure to educate the general community as to what their attitude towards the cripple

should be. It is along all these five lines that this preparation must take place, and every one of these lines demands the most accurate measurement of the human factors involved.

First, then the lack of realization of the difference between individual cripples lead in many instances to teaching them all the same kind of work. This was especially the case where the unfortunate choice was made not of work that was suitable, but of work that was easily taught, or worse yet, work that the available teacher happened to be able to teach. The mistake here was a particularly sad one, in that often this line of work was one that could not possibly appeal to anyone of a group of real men who had left real work in the industries or professions to go into the most strenuous of all activities at the front. It was unfortunate, also, that after the cripple had been taught, he was not in a position to look at his new work as a sporting proposition nor to earn an adequate living, nor was he at all satisfied to work permanently at the new work in which he had been most painstakingly taught. For example, many red-blooded men were seriously taught to make baskets, wonderful baskets, that all possible customers could easily go without, that were expected to be sold to people who bought the baskets through pity to help the makers, instead of as a commercial proposition (even our Indians have abandoned basket making because it is not sufficiently profitable). Most men of the type who have the spirit to fight for their country might be expected to work on baskets so long as they have attractive and interesting teachers, but when taught a trade requiring the variable of charity to be present at a sale of the product, would prefer, in the long run, to drown their sorrows in the standard manner. It must be remembered, then, that it is necessary to find a man's job for these red-blooded individuals, who, with the new opportunities, will be as strenuous in their determination as when they charged the enemies' trenches.

In some cases it is possible to assign a man to work which he has done before he had been injured, and to adapt the working equipment in such a way that he can make a satisfactory output at the work. In many cases it is possible to "reeducate" the man to do a type of work higher than any he has ever done. We have never, as yet, found a case where it was necessary to assign any man to work that could not be made interesting, stimulating and profitable.

The "mental" workers present the simplest problem. The "manual" workers of some education are also easily handled. The difficult element to handle consists of those who have never

had the benefit of education—the illiterates. But surprising results have been obtained in all countries, even among this class, where the individual to be placed has been studied with sufficient care. It goes without saying that the nature of the injury or maiming must be most carefully studied, also, and that this, along with the study of the mental training, and most especially *the ability to learn*, must be considered in the placement.

Second, as to the lack of realization of opportunities for cripples. In considering the cripple as a subject for placement, we must remember that there are many variables involved. There are the variables of the physical capabilities of the cripple himself, and of the possibilities of supplementing such limbs and faculties as he still possesses with such mechanical devices as are used so successfully by Professor Amar. The most rapid survey of the illustrations of any of the several wonderful accounts of the work being done by him, show that he has carried mechanical adaptation and supplementing of the capacities of the cripple to a truly marvelous extent.

Another variable is the amount of adaptation possible with the working equipment that the cripple is to use. We have already given an account of the possibilities of adapting the typewriter through the use of a double keyboard, of a supply of paper from continuous multiple rolls and other devices furnished us by the Remington, the Monarch and the Smith Premier Typewriter Companies, to the use of the crippled typist.* Another variable is the possibility of reeducation, mental and manual, of the cripple himself. Along with existing, realized and unrealized, opportunities for the cripple are others that result from the creation of lines of activity not yet existing, but much needed for the community good, such as that of Dental Nursing. This we have already described.* and need only say here that it consists of taking from the unfunctionalized over-burdened profession of Dentistry the routine work of cleaning the teeth, and assigning this to properly trained and inspected cripples, who will, under State Supervision and after the instruction of experts, supplement the work of the dentist, add to the health and wellbeing of the community, and at the same time furnish dental propholaxis at a price that the poor family can afford.

It is along this line that we make our first plea to you for co-

*"How to Put the Crippled Soldier on the Pay Roll." Presented at the Economic Psychology Association. Columbia University, New York.

*"The Conservation of the World's Teeth; A New Occupation for Crippled Soldiers." Conference Society for the Promotion of Occupational Therapy, March, 1917.

operation in finding jobs specially adapted to cripples. In your own particular occupation, no matter what it is, there undoubtedly exist opportunities for cripples, both discovered and undiscovered, and it is a part of your duty to your nation, and of your contribution to adequate preparedness, that you yourself discover these opportunities, record them and present them for national consideration. If you have a successful cripple in your employ, if you know a cripple who is a productive member of the community, his occupation must be one suitable for some other man crippled similarly, and it is your duty to record all existing data as fully as possible along such lines, noting particularly how he has achieved economic and industrial success, that others may be cheered and encouraged particularly during their transition periods. If you note in your observation of your own activity, or your own line of work, *any* places that could be filled by cripples of any possible type, it is your duty to record these also.

Of course, with the Simultaneous Motion Cycle Chart** it is possible to take almost any line of activity and study it and adapt it in such a way as to place a crippled worker at least a part of the activity. But there is one way in which your observations will have more value than will those made through the laboratory methods, i. e., the great immediate need of the man who has been crippled, after he has been made physically comfortable, is for encouragement and comfort. This can be obtained quickest through accounts of actual existing men who have suffered similar injuries and who have made good. If you will record these for his use in the most simple and elementary fashion, the human element there will at once make itself felt in the encouragement and heartening of the newly made cripple.

Third, you must realize the great need of supplying this incentive to live and this reeducation at the *earliest possible moment.* Mr. George E Barton, Director of the Consolation House in Clifton Springs, New York, who has had a long, most interesting and valuable experience with cripples, with maimed, and with convalescents of all kinds, agrees with us that the crucial period is at the earliest possible moment in the convalescence.* With the war cripples a serious complication occurs here if this stimulus is not at once supplied. In the case of those of much education and training, if there is no stimulus at this time, despair and direful consequences are more than apt to occur. If the man has not

**"Motion Study for the Crippled Soldiers." American Society of Mechanical Engineers, 1915.

*See papers by George Edward Barton, Clifton Springs, New York.

much education or constructive imagination, and the period of re-education is postponed—between the money that he receives without effort, and the misdirected sympathy of his friends, he is apt to fall into habits of idleness, if not worse, that are extremely difficult to overcome later. This is universally acknowledged by those both abroad and in this country who have worked with cripples.

Speaking of the money, or the pensions, it must be understood that nothing that we say in any way contemplates doing away with pensions. We agree with all those who sympathize with the cripples that they deserve—having "done their bit"—the thanks and reward of their country, and an opportunity to rest, if they so desire and if this is possible. However, the majority of them do *not* desire to remain idle, and it is necessary, for their own good as well as the good of the country, that they be allowed to supplement these pensions by all that they can earn and yet remain physically and mentally at their best.

It is necessary at this time to realize, also, that ability to supply this need when it arises depends largely upon our being prepared well in advance of the immediate need. On returning from two trips abroad after an extensive study of conditions there, and strenuously advocating general preparedness for our nation, we were laughed at as mad and foolish for thinking that this country would be involved in the great tumult abroad. Now, when we again advocate as warmly and as persistently preparing for this crippled soldier problem, we are again told, even in Washington, that we are "in advance of the times" and that "there is no need for haste in this matter." We wish to impress upon this Society most strongly, at this particular point, the need, if we are to conserve the best there is in our returning men, mentally and physically, of preparing for their reception and their reeducation at once.

To consider fourth the need for a social element in the work. Too much of the work assigned to and taught to cripples carries the inference that they will work either as "lone workers," in their homes, or in communities of cripples like themselves. Now, we all know there is no punishment like ostracism, there is nothing that troubles the average human being like being considered different from his fellows. We must make the cripple feel, from the earliest possible moment, that, in essentials, he is like every other member of the community, and that the quicker he "fits back" into the social and industrial life of the community, the better for the community as well as for his own self.

It is, therefore, with particular pleasure that we see some of the newer opportunities for cripples that are being discovered. We are glad to acknowledge here the hearty cooperation of the National Cash Register Company in discovering and recording such opportunities. There are opportunities in stores, opportunities for handling vending machines, for selling tobacco, papers, periodicals, candy, souvenir postcards; for tending and operating telephones and telegraphs, telautographs, cash registers, credit files, dictaphones and circulating libraries; opportunities for selling booths in hotel corridors; opportunities in small stores, and as ticket sellers and choppers in subway stations. When you realize what these opportunities are, and the broad field in which they lie, you will discover numerous opportunities in your own organizations, and can cooperate and assist us in bringing these to national attention. The great benefit of all of these opportunities is that utilizing them for cripples will not only free people for other lines of activity that demand "whole" workers, but that the cripples will enjoy social life as well as opportunities for productive work for the community.

Of course some suggested occupations will require the usual changes or adaptations. For example, an elevator operator's job requires no legs if the man be supplied with a stool. This is perfectly practicable in this country where there are no such ceremonies on entering and leaving a lift as exist abroad.

This leads us naturally to the fifth topic, the need of educating the public. Whenever we suggest a line of work—for example, Dental Nursing—as well adapted to the work of cripples, we are sure to hear the objection, that "the public does not wish to be brought into such close contact with the cripple." It "will never stand for that." Now the public must be educated, at the earliest possible moment, to the realization that the cripple is already an unrecognized large portion of the community, as can be easily realized by noting the large number of factories devoted exclusively to the manufacture of artificial limbs, and is destined to become a larger portion, as long as the war lasts and even after that, until we do away, as is possible to a greater extent, with industrial accidents. It is this feeling toward the cripple, which probably started in natural sympathy, and a desire to spare the cripple activity, that has resulted in making the average cripple feel that he is different from the other members of the community, and estranged from them, and it is this feeling that we must combat at the earliest and at every possible opportunity.

The pity for the cripple under the proper system of education should be supplemented by great admiration for the courage and expertness of the cripple, and by a desire to cooperate in making him a productive and a more satisfied member of the community. Again, the public must be educated as to the necessity of providing a definite livelihood for the cripple. It is not enough that we give the cripple a *chance* to earn a living, we must be sure that he *gets* the living. It is not enough to give him a "fair chance with other competitors," for he may not have been trained to meet the lifelong training of unhandicapped experts. It will be especially easy to emphasize the possibilities of giving and insuring this living to the cripples who are placed in these new types of little stores. This can be done, first, by sending the customers to him; next, by notifying all possible customers *who* and *where* he is; the "where" being taken care of by special signs on the street, such as druggists' signs in certain countries abroad; third, by notifying customers *what* he is; fourth, by providing such state or community controlled societies acting as jobbers for cripples who are comparatively small buyers who can handle small orders for the cripple, handle credits and take away the voucher of "deserving cripple in good standing," or "military cripple in good standing." These jobbers will afford us an opportunity of guiding the distribution, purchasing and selling expense of those who are handicapped as original producers, and help to turn the necessary unproductive expense due to distribution marketing and service over to those who are handicapped.

Again, the public must be educated to a feeling that after certain jobs have been designated as suitable for cripples they should, as soon as there are cripples to fill them, be reserved for these cripples. It should become at least "not fashionable" to do any work that can be done by a maimed man, nor to employ a whole worker in a job that can be properly handled by a cripple out of employment.

This readjustment is no new thing, nor is it one demanded only by the situation with regard to cripples. We have for years advocated the reclassification of the trades. This reclassification has always been needed. It happens that this new element in the problem, or rather the increased importance of this element at this time, makes the need for such reclassification and reassignment all the more important.

These, then, are the various factors of the cripple problem as they exemplify the need for measurement of the human factor.

and we bring them before this Society at this time because your cooperation is so necessary. Experts as you are, each in his particular line, each of you is making at this time a fight for measurement, for standardization, and for adequate preparedness. We urge you not only to continue this good fight, and to advocate that measurement be applied to all lines, but we urge you to consider this necessity of measurement as applied to the placement of the cripple as an excellent starting point.

The war cripple holds human interest today, anything that has to do with him grips the sympathies, and where the sympathies are once aroused, results will certainly follow, if we but persevere sufficiently. Now, there are two by-products to this, each of which is greater than the aforestated direct product.

1. The industrial cripples are much more numerous than the war cripples. This has always been so, and is true even in Canada today. Let us therefore take advantage of the present interest and enthusiasm to handle the problem of the industrial cripple whom we will have with us always.

2. The study of the special problems of the cripple, his capabilities for highest placement and success, his special and motion study education and guidance are better adapted to solve the problems of vocational guidance, placement, education and individual efficiency of the youth and workers of our country than all other known sources combined. This is particularly well shown by the fact that each of the successful studies that we have completed to enable the crippled to compete with the unmaimed has resulted in information or apparatus or less wasteful motions that have also been correspondingly useful and valuable for the unmaimed.

In other words, the cripples' needs are immediate. In serving him we are at the same time collecting the most valuable motion study data, and data relating to educational and industrial methods of least waste. This is a National need that one can realize better after talking with a keen observer who has recently returned from foreign travel, particularly from the far East.

Will you not therefore, in your consideration for, and in your work along the lines of the Human Factor in Industrial Preparedness, and in your advocacy of measurement along these lines, consider in your own particular work the military and industrial cripples, present and future, who need the results of this work so sorely, and cooperate, not only in finding opportunities for the

individual, but in educating the great public with whom you come in contact as to the needs, and also to the remedies for these needs? By so doing you will add to the productivity and wealth of our country and to the great sum total of the happiness minutes which are the ultimate units that we all aim to produce.

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